

# Storm-scale model initialization over oceanic regions using GLM convective information

Recent experiments at NOAA GSL

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GLM Science Meeting

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# RAP/HRRR Systems

-20 min.      -10 min      Initialization      10 min.



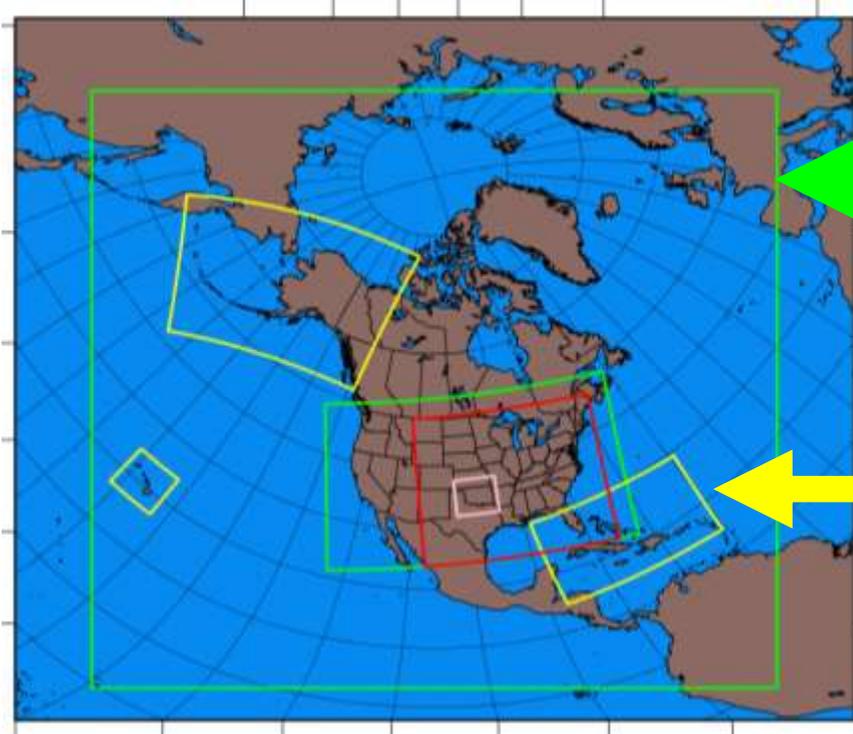
Backwards Integration,  
no physics

Obtain filtered state from  
adiabatic integration and use  
as initial field for forward  
diabatic integration

Forwards Integration,  
Full physics

Obtain filtered initial fields  
with improved balance,  
vertical circulations  
associated with ongoing  
dynamical processes

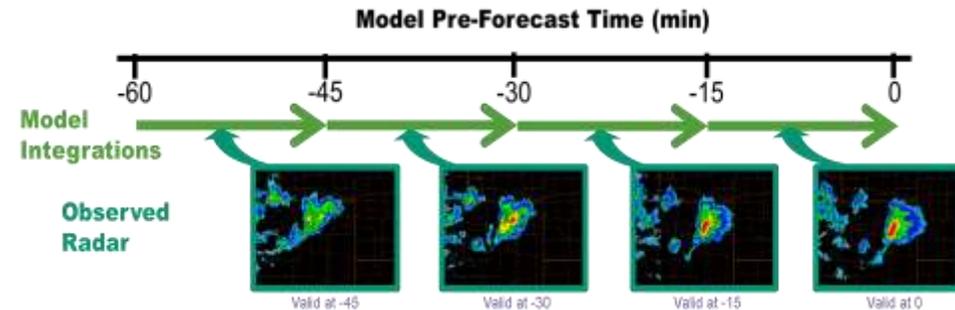
Adjust mixing ratio fields  
based upon relative humidity  
analysis and generate RAP  
model forecast



RAP: 13.5-km  
resolution over N.  
America and  
oceans

HRRR-CAR: 3-km  
resolution  
including Cuba,  
Hispaniola, Puerto  
Rico, Bahamas, FL

RAP  
DFI



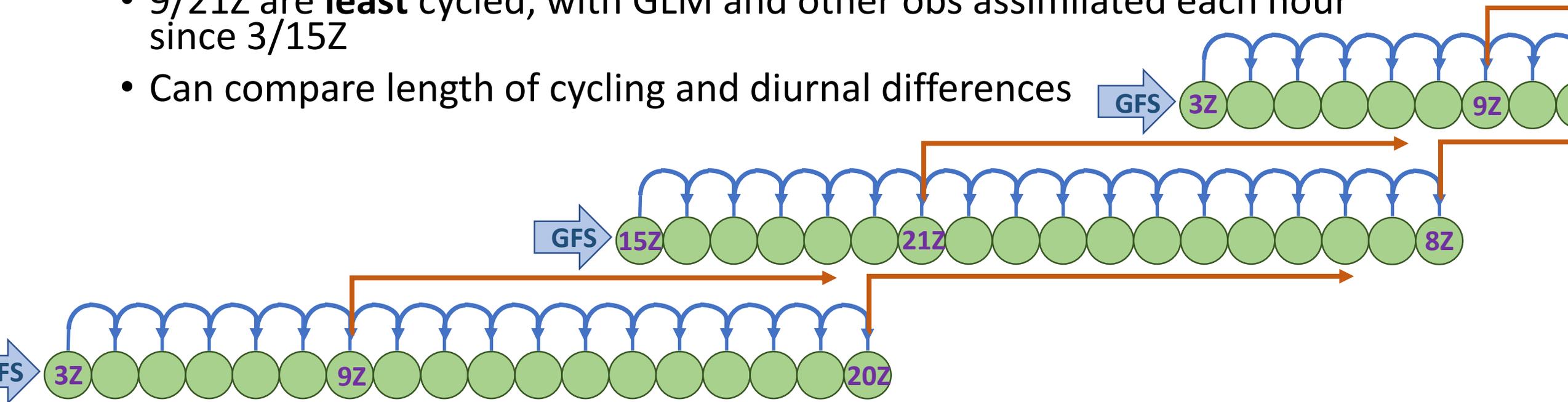
HRRR 'pre-forecast'

("Implementation of a Digital Filter Initialization in the WRF Model and Its Application in the Rapid Refresh," Peckham et al. 2016)



# Real-time experiments (RAP)

- 2 flavors:
  - **CONTROL** like RAPv5 (radar, ground-based lightning, other obs)
  - **EXPERIMENT**: all of the above + merged lightning dataset **including GLM**
- 44 12-hour forecasts, Jul 19 – Aug 6, 2020
- Initialize at 8/20Z and 9/21Z
- RAP cycling: 8/20Z are **most** cycled, with GLM and other obs assimilated each hour since 15/3Z
- 9/21Z are **least** cycled, with GLM and other obs assimilated each hour since 3/15Z
- Can compare length of cycling and diurnal differences



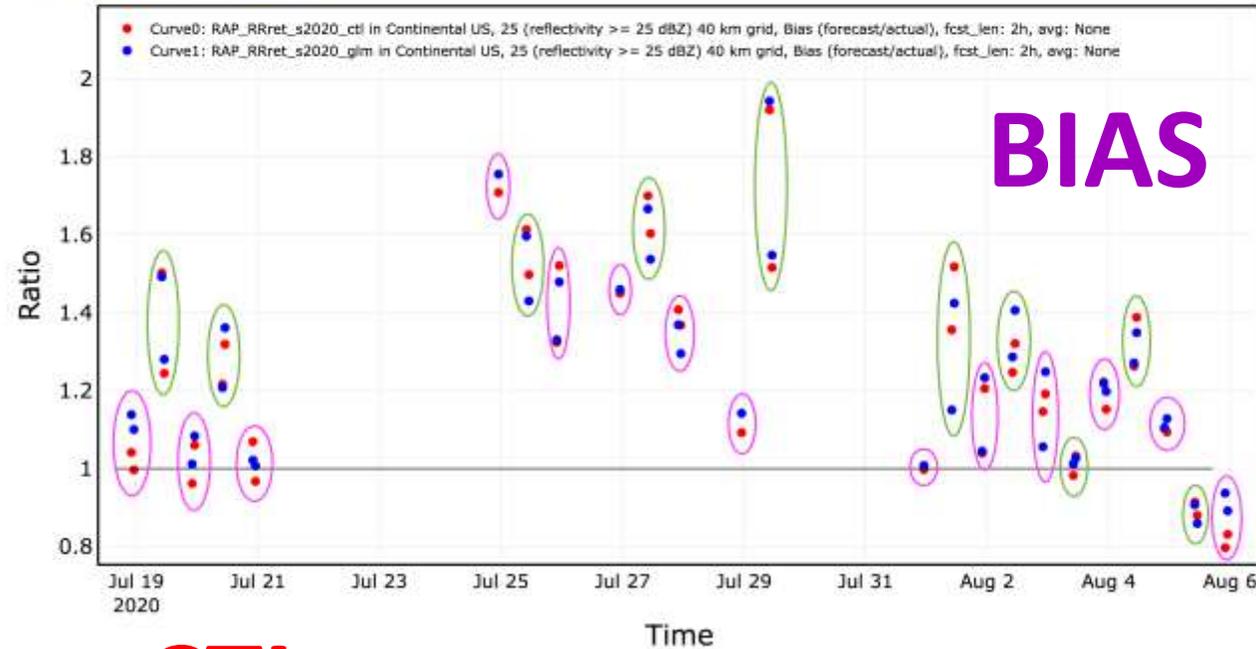


# CONUS RAP verification vs. MRMS



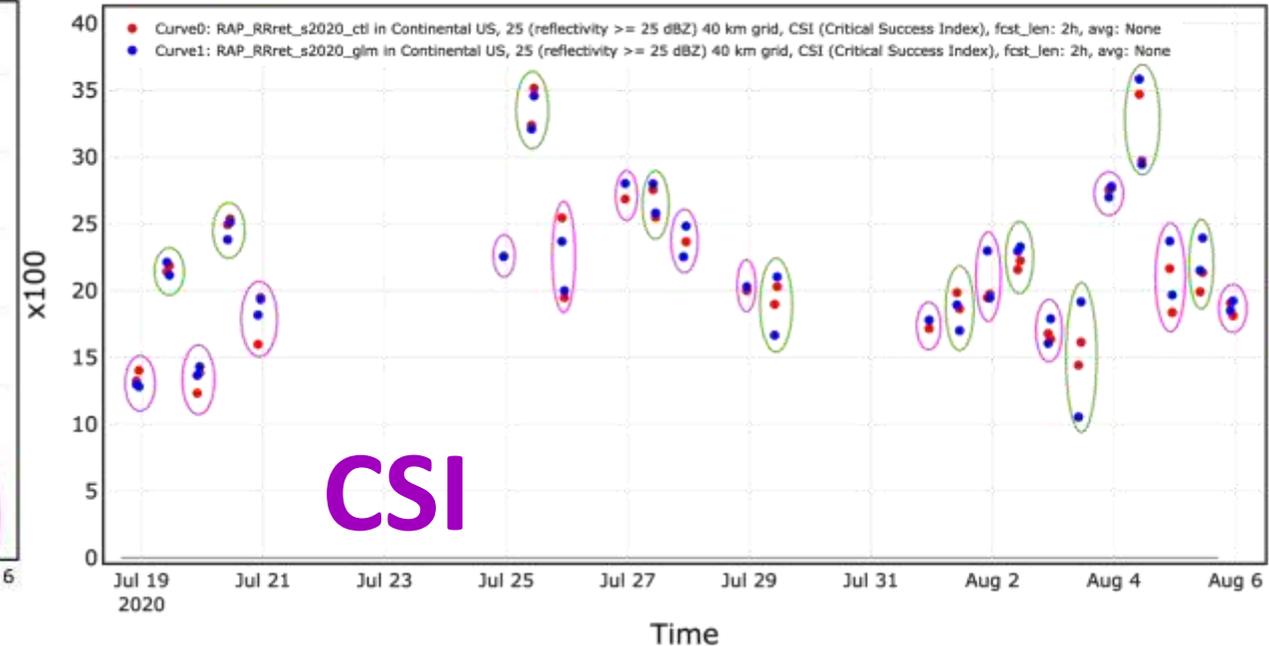
Composite Reflectivity : TimeSeries 07/18/2020 20:00 - 08/06/2020 12:00 : no diffs MATCHED

Curve0 mean = 1.245, median = 1.220, stdev = 0.2038  
Curve1 mean = 1.290, median = 1.226, stdev = 0.2398



Composite Reflectivity : TimeSeries 07/18/2020 20:00 - 08/06/2020 12:00 : no diffs MATCHED

Curve0 mean = 21.45, median = 20.15, stdev = 5.395  
Curve1 mean = 21.74, median = 21.34, stdev = 5.461



**CTL**

**+GLM**

44 2-hour forecasts, Jul 19 – Aug 6, 2020

verified over CONUS

40 km grid – 25 dBZ threshold

**But we are most interested in model skill outside radar range**



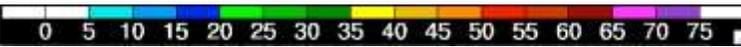
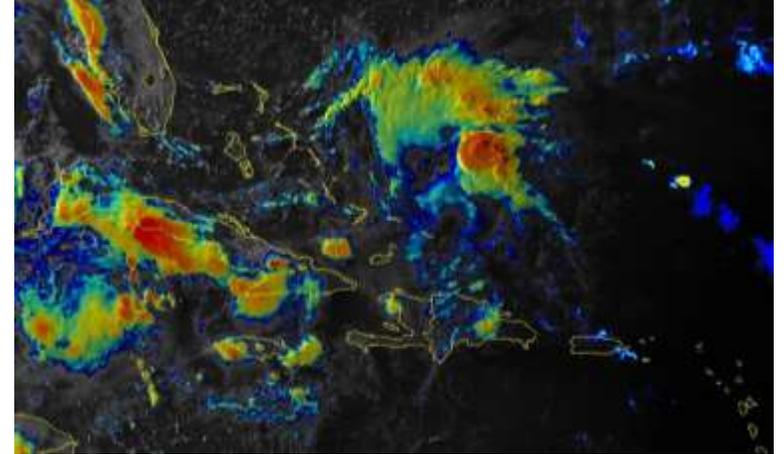
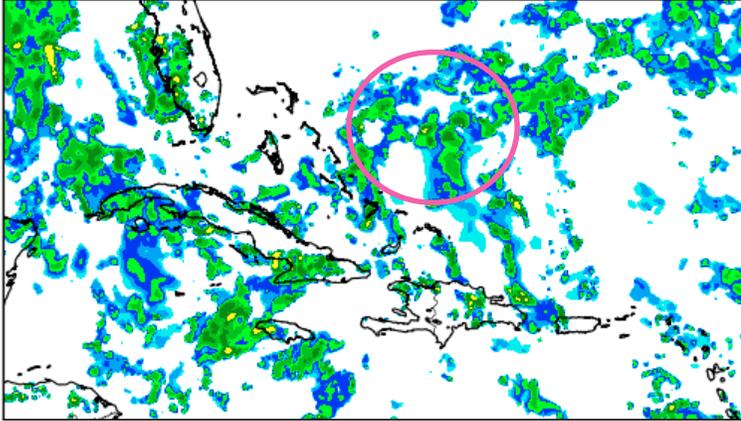
# RAP convective forecasts

NO GLM 7/24/2020 20Z+3

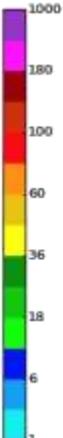
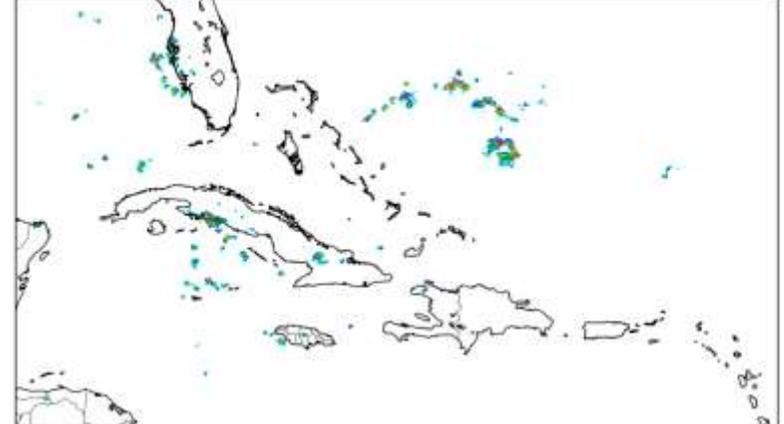
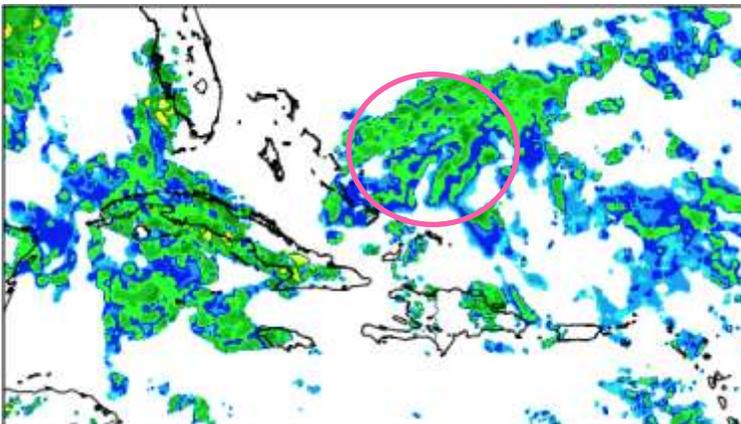
GLM 7/24/2020 20Z+3

NOAA "SANDWICH" ABI valid 23Z

Most Cycled



Least Cycled



NO GLM 7/24/2020 21Z+2

GLM 7/24/2020 21Z+2

15-MIN GLM GROUPS valid 23Z



# RAP convective forecasts

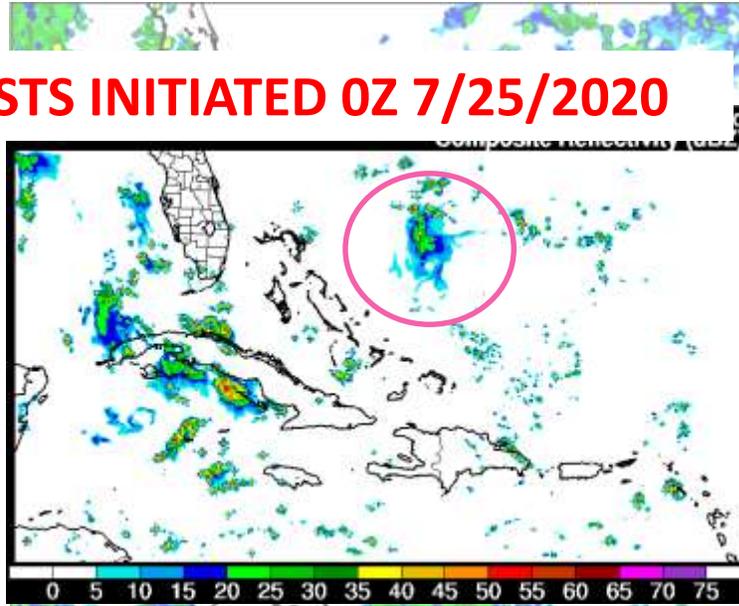
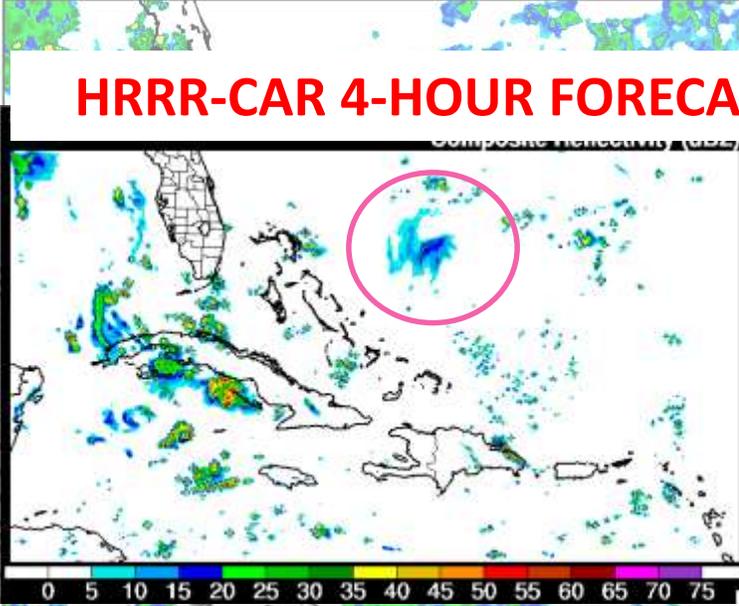
NO GLM 7/24/2020 20Z+3

GLM 7/24/2020 20Z+3

NOAA "SANDWICH" ABI valid 4Z

**HRRR-CAR 4-HOUR FORECASTS INITIATED 0Z 7/25/2020**

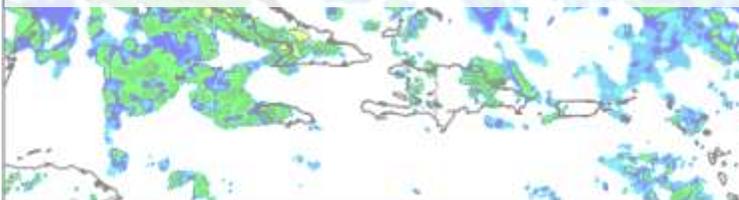
Most Cycled



Least Cycled

**CTL RAP BACKGROUND**

**+GLM RAP BACKGROUND**



NO GLM 7/24/2020 21Z+2

GLM 7/24/2020 21Z+2

15-MIN GLM GROUPS valid 4Z



# Real-time experiments (HRRR-CAR)

- 12-hour forecasts initialized at 0 and 12Z during RAP experiment period, using RAP IC/BC
- 4 configurations:

<b>NO GLM ASSIMILATION</b>	<b>GLM ASSIMILATION IN RAP</b> <b>NO GLM ASSIMILATION IN HRRR</b>
<b>NO GLM ASSIMILATION IN RAP</b> <b>GLM ASSIMILATION IN HRRR</b>	<b>GLM ASSIMILATION IN RAP</b> <b>AND GLM ASSIMILATION IN HRRR</b>



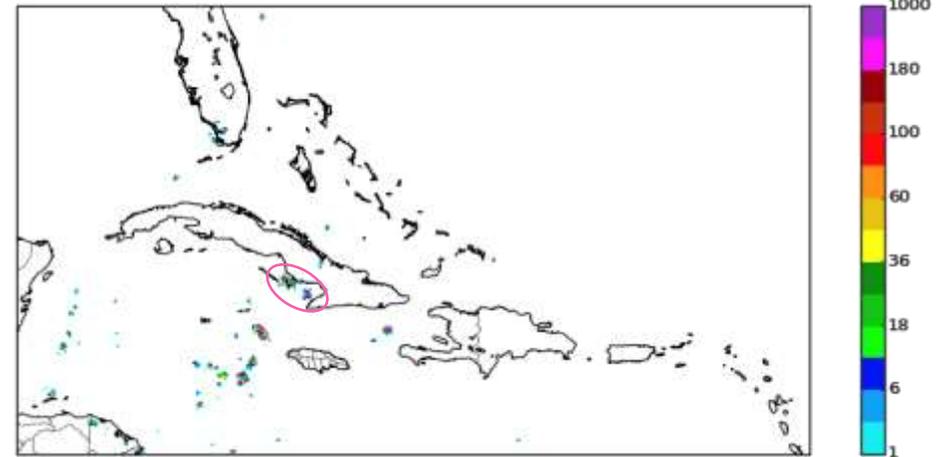
# 8/5/2020 0Z+3 CREF



### NO GLM

### RAP GLM

### NOAA "SANDWICH" ABI valid 3Z



### HRRR GLM

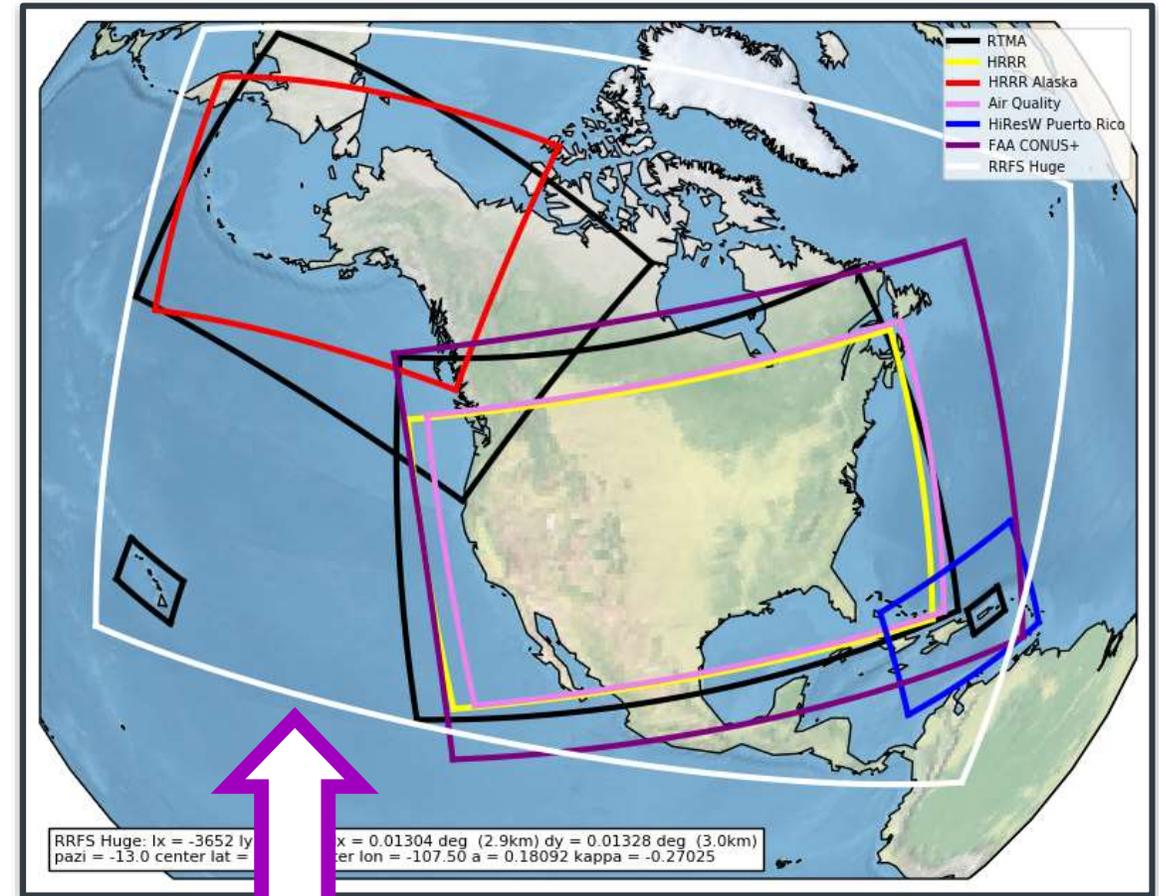
### RAP+HRRR GLM

### 15-MIN GLM GROUPS valid 3Z



# Future Work

- Analysis of these experiments still underway
- GLM assimilation permanently part of real-time RAPX/HRRRX following autumn code freeze
- Pre-forecast hour for next-gen RRFS in development
- Other radar/lightning assimilation strategies being evaluated
- Formalize verification processes using satellite obs



**Proposed RRFS (3 km) domain coming 2023**